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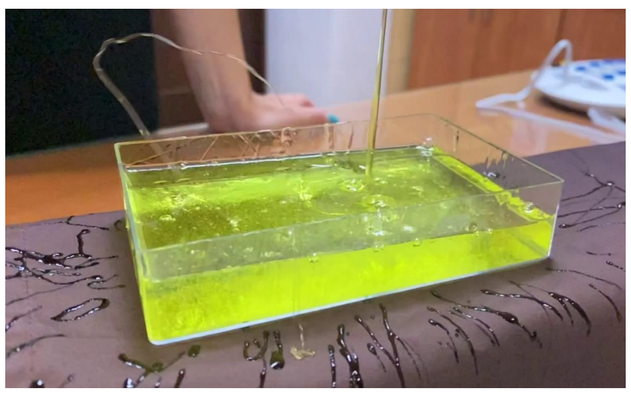
DIVERSITY
in STEM Education

Magdalena Grygiel | High School of Nicolaus Copernicus | Kalisz | Poland

Investigating optical properties of non-Newtonian liquid

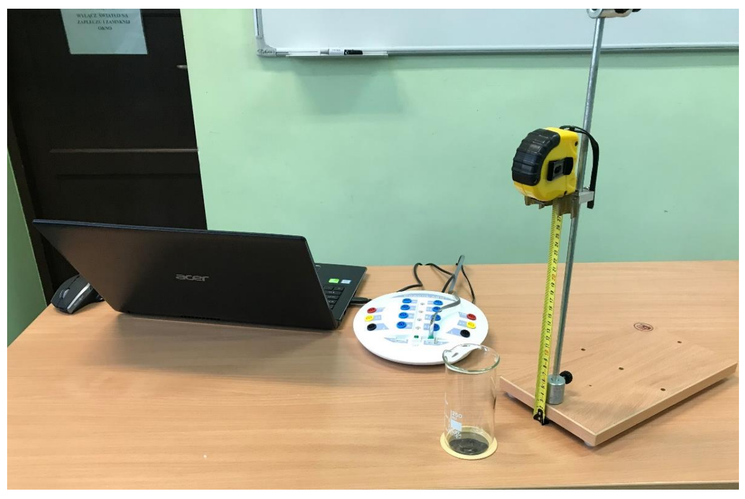


The Kaye's effect occurs when a thin stream of non-Newtonian liquid is poured onto a surface. Suddenly, a small stream of liquid occasionally leaps upward from the heap. This effect is named after its first observer A. Kaye.

Bouguer's law

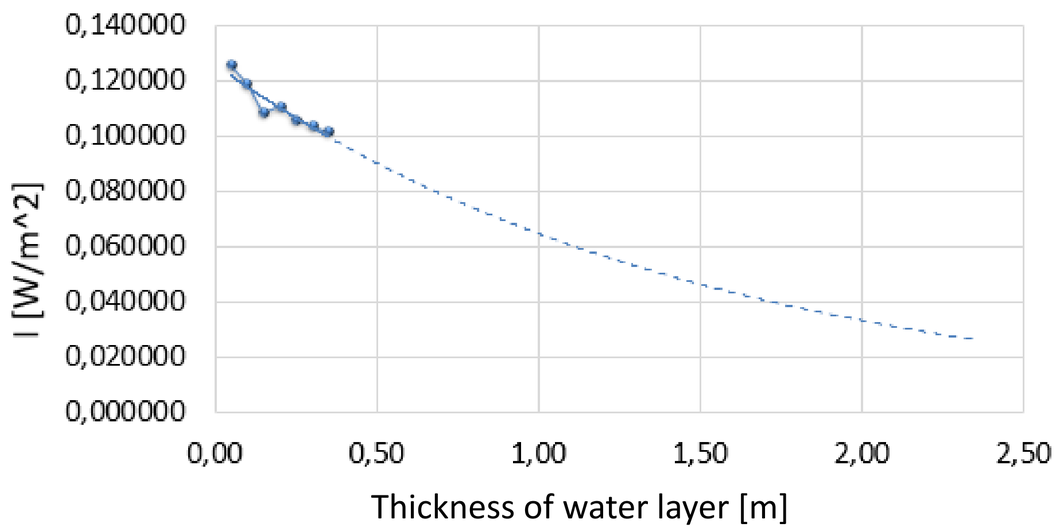
$$I(x) = I_0 e^{-\alpha x}$$

x – thickness of liquid layer
I_0 – intensity of light
α – absorption coefficient



Experimental set

Testing Bouguer's law of light absorption in non-Newtonian liquids.
As control samples we used water, colored water and canola oil. We changed the layer of water (and other liquids) thickness and measured light intensity by a sensor and COACH LAB II+. We tested non-Newtonian liquids: shower-gel, honey and slime. Graphs present our results.



Conclusion: non-Newtonian liquids obey the Bouguer's law just like ordinary Newtonian liquids.

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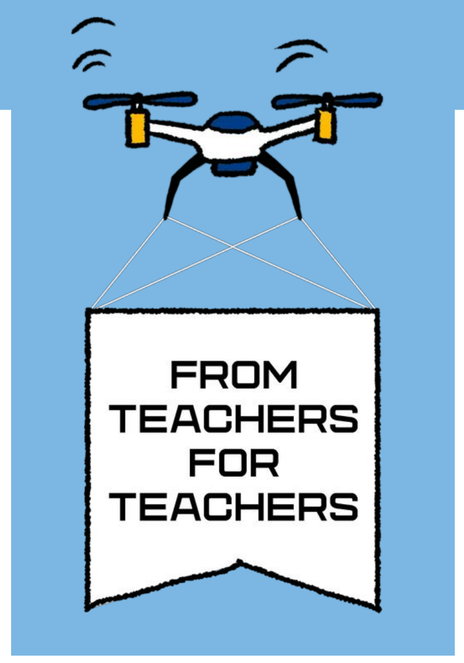

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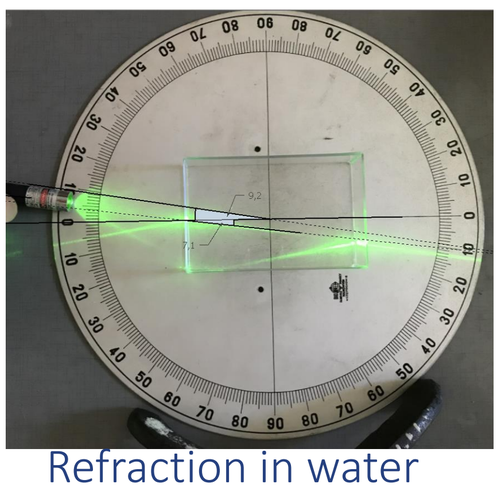
Investigating optical properties of non-Newtonian liquid

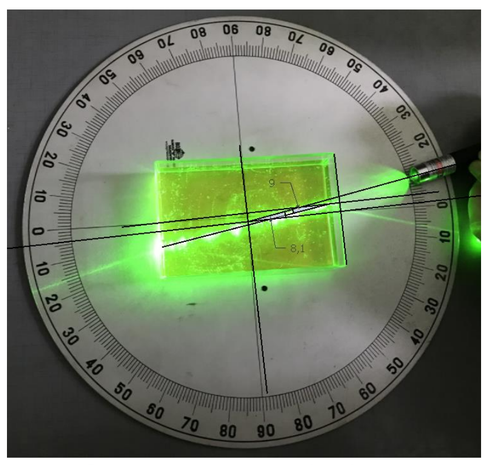
Observation of refraction in non-Newtonian liquids gave an opportunity to take photos and by using sfotware to determine angels of incidence and refraction light in water (as a control sample), dish soap and slime. The experimental results were used to calulate the speed light propagation in the liquids by using MS Excel.

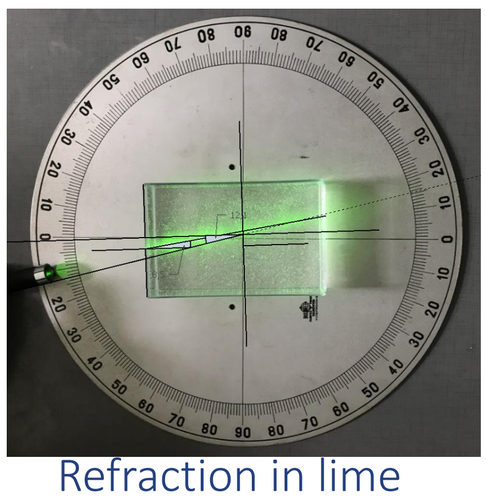
Calculation of light speed in liquid

$$\frac{\sin\alpha}{\sin\beta} = \frac{c}{v} \rightarrow v = c\frac{\sin\beta}{\sin\alpha}$$

α – angle of incidence
β – angle of refraction

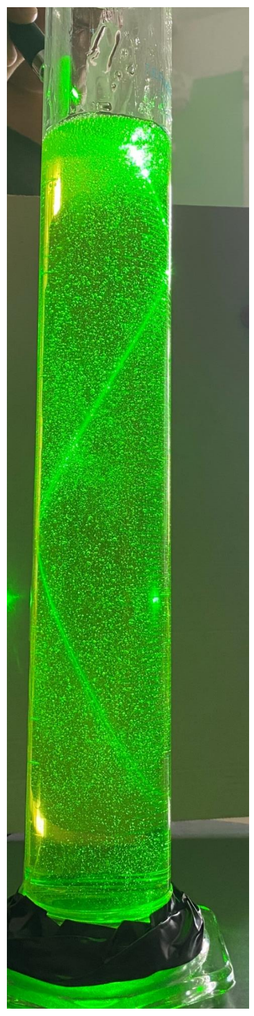

Refraction in water


Refracrion in dish soap


Refraction in lime

liquid	water	dish soap	slime
α	9,2	9,0	12,1
β	7,1	8,1	8,5
v [$\cdot 10^8$ m/s]	$2{,}316 \mp 0{,}068$	2,700	2,114

Tab. Experimental results, for water it was possible to calculate measurement uncertainty.



In non-Newtonian liquid phenomenon of total internal reflection is also observed. The photo presents the phenomenon in shower-gel.

Special thanks to my studenst: Hanna Kłysz, Ada Wojterska,
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Conclusion: optical properties of non-Newtonian liquids are similar to Newtonian liquids.